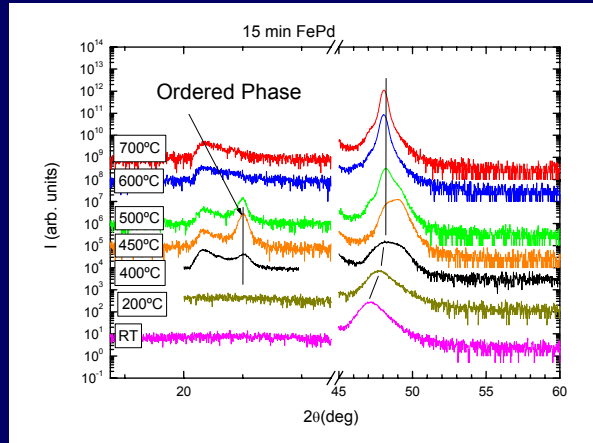


Highly anisotropic nano-magnets

Rosa A. Lukaszew, University of Toledo, DMR-0355171

Motivation

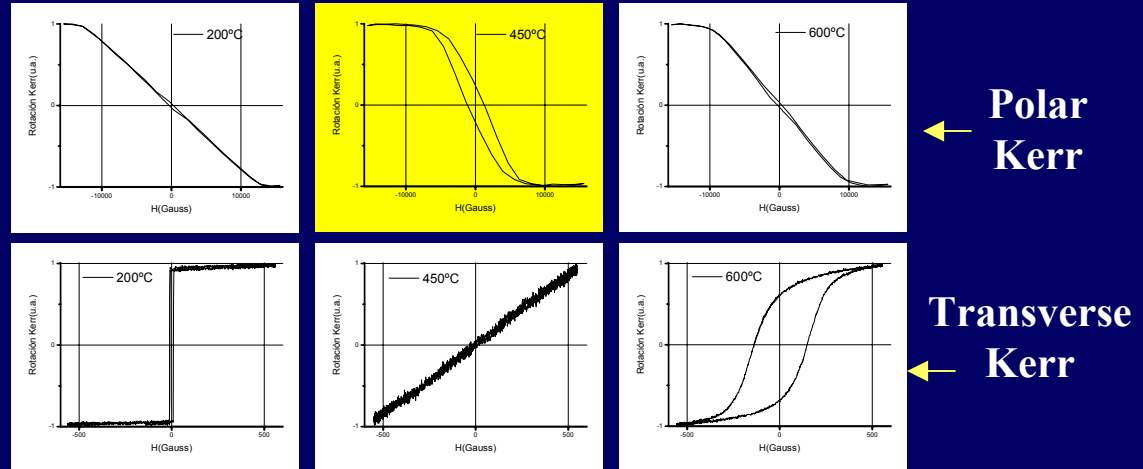
Nano-magnets made with $L1_0$ binary alloys are of interest because they exhibit extremely large magnetic anisotropy and thus can withstand the super-paramagnetic limit.



The optimum temperature for substantial formation of the $L1_0$ ordered phase during growth of FePd films was monitored with XRD. The ordered phase formed at 450 °C.

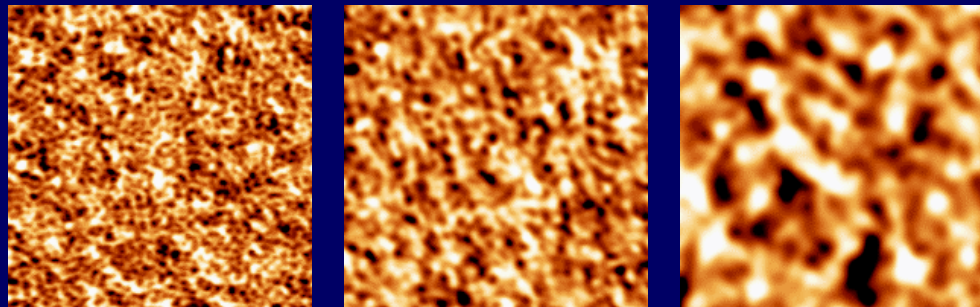
The goal is now to study $L1_0$ nano-structures in FePt films which exhibit even higher magnetic anisotropy than FePd.

Kerr magnetometry evidenced the **perpendicular** anisotropy that arises when the $L1_0$ phase is formed in FePd Films.



MFM images of $L1_0$ FePd films

The images show domain-size configuration that scales with film thickness.



30 nm

15 nm

5 nm

Highly anisotropic nano-magnets

Rosa A. Lukaszew, University of Toledo, DMR-0355171

Broad Impact:

- Sample growth and structural characterization were performed in collaboration with the Madrid Institute of Microelectronics (IMM), Madrid, Spain. Publication will have IMM co-authors.
- A proposal for rapid thermal annealing (XRTA) and characterization of $L1_0$ FePt films has been submitted to the Advanced Photon Source (APS), Argonne National Laboratory.
- Ion-implantation studies to induce highly ordered FePt $L1_0$ crystallites on epitaxial films are currently being carried out at the University of Toledo.

Education:

One graduate student and one undergraduate student are involved in this work.

- Upon return from the first trip to Spain, the PI organized two outreach programs for the Toledo community: Saturday Morning Physics and Physics Summer Camp. Aspects of the work described here were presented at these events to showcase the scope of the research carried out at the University of Toledo.
- Nicholas Sperling, a junior undergraduate student at the University of Toledo, has worked on ion-implantation simulations to specify the optimum parameters to induce highly ordered crystallites on thin film samples.
- Graduate student Mukut Mitra has conducted magnetic and magneto-transport characterization of the FePd samples and will be involved in the XRTA studies on FePt at the Advanced Photon Source. He will also participate in ion-implantation experiments and further sample characterization.